Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

2 5 T 2
Cop 2

STATION PAPER NO. 5 DECEMBER 1946

# LAKE STATES FORESTS AND THE PULP AND PAPER INDUSTRY

E. L. DEMMON

LIBRARY
CURRENT SERIAL RECORD
APR 16 1947
U. S. DEPARTMENT OF AGRICULTURE

LAKE STATES FOREST EXPERIMENT STATION
UNIVERSITY FARM, ST. PAUL 1, MINN.
E. L. DEMMON, DIRECTOR

U. S. Department of Agriculture, Forest Service
Lake States Forest Experiment Station [1]

---

Station Paper No. 5 December 1946

---

# Lake States Forests and the Pulp and Paper Industry [2]

E. L. Demmon, Director

For more than half a century the Lake States region (Michigan, Wisconsin, and Minnesota) has been an important factor in the national production of pulp and paper. At present, there are 131 paper and paperboard mills in the region, 39 of them operated in connection with pulp mills. Five additional pulp mills make no paper.

From 15 percent of national wood pulp production in 1904 (300,000 tons), the region's proportion reached a peak of 25 percent in 1926 (1.1 million tons). Although production averaged about 1.4 million tons annually during the five war years (1941-45), national production had also climbed, so the Lake States accounted for only 14 percent of the total. 42 percent of the Lake States' current pulp production is sulphite (representing a fourth of U. S. production); groundwood (35 percent), sulphate (21 percent), and soda (1.5 percent) pulp make up the balance.

Paper production in the Lake States has increased greatly in recent years, from about 1 million tons in 1920 to 3 million tons annually in recent years. At present, the Lake States region produces about one-sixth of the paper output of the country, representing a great diversification of types of paper and paperboard, much of it of high quality. Principal items manufactured are book paper (28 percent of national production), fine papers (25 percent), wrapping paper (22 percent), sanitary paper (28 percent), tissue paper (35 percent), folding boxboard (22 percent), and building board (20 percent). As recently as 1929, about one-fifth of the nation's production of newsprint came from this region, but the increased scarcity and high cost of spruce has gradually eliminated this product in the region.

The pulp and paper industry in the Lake States is not self-sufficient in local sources of raw material. In recent years the region has imported about one-fourth of the pulpwood it consumes--mostly spruce and balsam fir from Canada. Scandinavian countries contributed a small part of the region's wood pulp needs prior to the late war and have already resumed shipments on a limited basis. The consumption of waste paper, rags, straw, etc. amounts to about 40 percent and new wood pulp 60 percent of the total fiber used in the region's paper production. Because the Lake States pulp and paper

---

[1] Maintained at University Farm, St. Paul, Minnesota in cooperation with the University of Minnesota.

[2] Paper presented at annual meeting of the Technical Association of the Pulp and Paper Industry at Detroit, Michigan, September 26, 1946.

industry depends so largely on wood as its chief raw material, it is important to know the quantity, quality, and availability of present and prospective wood supplies and the relation to other forest-products industries dependent on the same source of supply.

## The Regional Timber Resource

### Forest Area and Timber Volume

The Lake States region has some 50 million acres of commercial forest land, nearly 11 percent of that in the nation. However, the original forest has been so heavily cut over that the present saw timber volume (51 billion board feet) amounts to only about 3 percent of the nation's total. The condition of this forest land in 1945, as shown by the character of forest growth, is given in table 1.

Table 1.--Condition of commercial forest land in Lake States, 1945.

| Character of growth | Stand or stocking per acre | Area | Proportion |
|---|---|---|---|
| | | Millions of acres | Percent |
| Saw timber | 2 M ft. or more | 6.5 | 13 |
| Pole timber | 3 cords to 2 M ft. | 9.5 | 20 |
| Seedlings and saplings | Under 3 cords; but more than 40 percent stocked | 20.5 | 40 |
| Poorly stocked or denuded | Under 3 cords; and less than 40 percent stocked | 13.9 | 27 |
| Total | | 50.4 | 100 |

Only about 1.5 million acres of the region's saw timber is in old-growth stands; the remaining 49 million acres of forest is in second growth stands or in denuded areas. The large proportion of land that is understocked and denuded indicates clearly that the forest potentialities of the region are far from being realized.

Although the bulk of the region's pulpwood supplies comes from trees not merchantable for sawlogs, some of the sawlog-size trees also go into pulp, especially hemlock. Present timber stands, summarized by principal pulwood species, are given in table 2.

Table 2.--Volume of principal pulpwood species on commercial forest land in Lake States, 1945.

| Pulpwood species | Merchantable volume | | | Percent |
|---|---|---|---|---|
| | Below sawlog size | Sawlog size | Total | |
| | Millions of cords | | | |
| Spruce | 7.1 | 6.1 | 13.2 | 16 |
| Balsam fir | 9.1 | 2.5 | 11.6 | 14 |
| Hemlock | 3.0 | 12.6 | 15.6 | 19 |
| Jack pine | 5.3 | 5.1 | 10.4 | 12 |
| Aspen | 17.3 | 15.3 | 32.6 | 39 |
| Total | 41.8 | 41.6 | 83.4 | 100 |

Material of sawlog size is utilized either for saw timber or for pulpwood, depending on price and other considerations.

Many million cords of northern hardwoods (mostly maple, oak, birch, and elm) are available for pulping at such time as the demand arises. (See table 3.)

Table 3.--Volume of hardwood cordwood (except aspen) in Lake States - 1945.

| Hardwood species | Volume | | |
|---|---|---|---|
| | Tops, limbs, and cull logs in saw timber stands 1/ | Thinnings in pole and sapling stands 2/ | Total |
| | Millions of cords | | |
| Sugar maple | 125 | 35 | 160 |
| Oak | 76 | 59 | 135 |
| Yellow birch | 56 | 24 | 80 |
| Basswood | 32 | 22 | 54 |
| Beech | 20 | 6 | 26 |
| Elm | 49 | 26 | 75 |
| Soft maple | 24 | 26 | 50 |
| Paper birch | 20 | 30 | 50 |
| Miscellaneous | 28 | 42 | 70 |
| Total | 430 | 270 | 700 |

1/ Approximately 1.5 cords per 1,000 board feet of merchantable saw timber to 4" top; 40 percent plus sound.
2/ Approximately half of the pole timber volume. Trees 5" to 11" diameter, to 4" top.

## Timber Quality

It is estimated that about one-fifth of all timber of merchantable size in the Lake States is of such poor quality, small size, scattered occurrence, or remote location that it cannot be profitably harvested and utilized under current market conditions. For example, one-third of the present 20 million acres of aspen, which has replaced the original white and red pine on many areas, is growing on dry, light, sandy soil and is termed "off-site." Under these conditions aspen grows slowly and begins to deteriorate at an early age. About 3 cords of pulpwood per acre is an average stand on these poor sites, and seldom does it exceed 5 or 6 cords. During the war, pulp mills accepted much low-grade aspen of this type, but it is questionable whether such material can be handled profitably at present. Undoubtedly, proper management can improve the quality and yields from inferior aspen stands.

## Forest Land Ownership and Management

The cutover region of the Lake States has long been an outstanding example of heavy tax delinquency, and at least 13 million acres of forest land have reverted to state and county ownership because of tax default.

All told, about 43 percent of the forest land in the region is in public ownership--13 percent is held by the Federal government and 30 percent by the states, counties, and municipalities. 57 percent is held by private owners, the great majority being farmers. Only about one-fourth of the commercially available timber is controlled by large operators.

Some of the larger lumber companies are liquidating their holdings; a few with vision are practicing good forest management. Farmers and other small owners have lacked facilities and inducements to put their woodlands under good management.

It is gratifying to note that within the past few years many pulp mill owners are acquiring an appreciable amount of forest land. Some of these operators have expressed as a goal the acquisition of sufficient land to produce at least 50 percent of their pulpwood requirements.

A good example of what one pulp and paper company is doing is furnished by the Nekoosa-Edwards Paper Company, of Port Edwards, Wisconsin. They own about 110,000 acres of jack pine and cut over lands supporting second-growth pine, spruce, balsam, aspen and birch. During the past 15 years this company has planted about 15,000 acres successfully.

## Location of Available Pulpwood

The only undeveloped pulpwood logging chances of substantial size in the Lake States are in northern Minnesota, particularly within the boundaries of state and national forests. 70 percent of the Lake States' remaining supply of jack pine is in Minnesota and 33 percent is within the boundaries of the Superior National Forest. The sale of about 750,000 cords of pulpwood on an area of about 95,000 acres was made there recently. Logging within the Superior National Forest, however, requires large investments in roads and other improvements.

## Growth

The current (1945) annual growth of wood of all kinds and sizes in the Lake States is about 812 million cubic feet (made up of 1.4 billion board feet in sawlog size trees plus 5.8 million cords in smaller trees). However, not all of this growth is on trees of the right species, size, and location to be valuable to existing forest industries. The realizable growth (or what foresters call allowable drain) on trees suitable for pulpwood at the present time is only about 1 million cords of spruce, balsam fir, jack pine, and hemlock (plus 1/2 million cords in saw timber sized trees), and 2 million cords of aspen (plus 1 million cords in saw timber sized trees) annually. Under proper forest management, Lake States' forests are capable of yielding two to three times this current growth.

## Commodity Drain

Cutting for pulpwood during the last 10 years accounted for about 20 percent of the forest commodity drain in the Lake States. (By 1944 it had reached 26 percent.) Cutting for lumber amounted to 44 percent, and fuelwood about 20 percent of the total commodity drain. Other less significant items are veneer logs, fence posts, and mine timbers.

Total drain on standing pulpwood material (trees of pulping species, below sawlog size) averages about 2.3 million cords per year--one-fourth less than the calculated allowable drain of 3.0 million cords based on current annual growth. However, this favorable balance of growth over drain is created solely by the large volume of nonutilized aspen. In the more valuable softwood species--spruce, fir and pine--recent drain is 40 percent greater than can be sustained by these species on a permanent basis. In 1944, drain exceeded growth by 80 percent. An unfavorable balance also exists in timber of sawlog size.

Table 4 presents the current and prospective pulpwood situation by species.

Table 4.--Supply and drain on Lake States pulpwood supplies (below sawlog size).

| Pulp species | Supply 1945 | Allowable drain 1/ | Actual average drain (for all purposes) 1935-44 | 1944 |
|---|---|---|---|---|
| | Thousand Cords | | | |
| Spruce | 7,100 | 130 | 370 | 377 |
| Balsam fir | 9,100 | 290 | 226 | 277 |
| Hemlock | 3,000 | 240 | 664 | 584 |
| Jack pine | 5,300 | 285 | 389 | 611 |
| Aspen | 17,300 | 2,040 | 700 | 733 |
| Total | 41,800 | 2,985 | 2,349 | 2,582 |

1/ Amount of material below sawlog size that could be removed annually during next 20 years under a conservative form of management. Cuts would exceed annual growth in fully mature stands, with lighter cuts in second-growth and pole stands, where most of the growth is on immature trees.

## Noncommodity Drain

The average annual loss by fire, insects, disease, windstorm, etc. during recent years has been much less than formerly and reflects greatly improved fire protection as well as a series of years with relatively high rainfall. However, some of the most severe losses have been in pulpwood species, particularly hemlock, pine, balsam fir, and aspen. Fortunately, good markets during the war years permitted salvage of much material that ordinarily would have gone to waste.

No extremely large fires have occurred in the Lake States in recent years. The extensive areas of slashings which formerly burned at frequent intervals, are now largely covered with second-growth timber which reduces the fire hazard. Practically all forested areas are now accessible to motorized fire-fighting crews and equipment. Although large fires are still possible, the risk of great loss has been effectively reduced.

The region has suffered relatively light losses from insect and disease epidemics in recent years. The most severe attack was from the larch sawfly, between 1910 and 1926, which practically wiped out the mature tamarack in the region. The spruce budworm caused severe damage to spruce and balsam fir from 1913 to 1923. White pine blister rust, forest tent caterpillar, spittle bug, and hypoxylon canker of aspen have caused extensive losses locally at various times. Also, forest reproduction is often seriously injured or killed by snowshoe hares, deer, sawflies, and the white pine weevil.

## Waste

In Lake States pulpwood operations there is relatively little wood waste in the usual sense. Pulpwood, as a rule, is harvested to a 4-inch top diameter (100-inch sticks) and experiments are being conducted to determine the feasibility of using spruce to a 2.5-inch top diameter. Many hemlock logs which would be considered cull for saw timber operations are accepted by pulp mills. Several thousand cords of slabs and edgings from sawmills and veneer cores are used annually by pulpmills. Much aspen, of course, dies on the stump for lack of a market.

## Effect of Cutting Practices

Destructive logging is still a problem in the Lake States. With but few exceptions, hardwood logging operations are conducted on practically a clear-cutting basis, cutting all trees 14 inches in diameter (breast height) and over. In the vicinity of mining communities, sawlog operations frequently are followed by cutting of smaller trees for mine timbers, or railway cross ties. Unless the slash is burned, a reasonably full stand of young northern hardwoods (mostly birch and maple) is generally secured but there is little advanced growth and consequently another harvest cut cannot be made until the distant future. Under this clear-cutting practice, most of the old-growth hardwoods will be gone in 15 to 20 years, and hemlock will have largely disappeared also.

In second-growth forests the most serious loss of potential growth is from premature cutting just as the stand approaches optimum growth. During the war, the demand for pine, spruce, and other softwoods was so great that almost any size and quality of material was acceptable. Cutting not only for pulpwood but also for lumber, boxes, and crating resulted in liquidating many thrifty young second-growth stands. Instances have been noted where 5-inch pines were cut into 2x4's. It is estimated that about half of the cut of spruce, pine, and balsam fir comes from immature stands. If these stands were thinned and improved by partial cuts, growth could be increased and the long-time needs of the pulp industry would be better met.

## Reforestation Progress and Possibilities

Regular programs of forest planting have been under way in the Lake States since about 1910, although a few farmers' plantations were begun as early as 1876. The area planted annually was of limited extent until the advent of the Civilian Conservation Corps program in 1933, when public land planting increased from a few thousand acres to an average of nearly 100,000 acres per year. A total of about 1-1/3 million acres has now been planted in the

three Lake States and an estimated 13 million acres additional in need of planting. Sufficient public forest nursery capacity is now available to supply stock to plant about 135,000 acres per year. It has been amply demonstrated that forest plantings in the Lake States, using proper techniques and care, will be successful.

## Other Facts Relating to Timber Resources

Pulp and paper companies have been pressed for raw material since before the war. Canadian pulpwood sources have been limited by certain restrictions and by the policy of requiring that a portion of Canadian pulpwood be manufactured into pulp before being exported. However, slightly over one-fourth of the pulpwood processed each year in the Lake States comes from Canada. The Wisconsin pulp and paper companies import about two-thirds of their pulpwood, drawing heavily upon Michigan and Minnesota resources as well as those of Canada. Recently, some Wisconsin mills have gone as far as Montana and Idaho for pulpwood. Some are buying timberlands in Michigan and Minnesota. There are opportunities for pulp companies to associate themselves with lumber and veneer companies for integrated operations, utilizing material that would otherwise be largely wasted.

## Competition for Available Timber Supply

Lumbering reached its peak in the Lake States about 50 years ago when the annual cut was about 10 billion board feet. During the last 40 years there has been a sharp decline both in volume of lumber produced and in the number of large sawmills operating. Production in recent years has leveled off at a little over one billion board feet per year.

Although saw timber production may continue to decline for some years in the Lake States, this need not be the case with pulpwood production. Because of the shorter time required to reach merchantable size, it is logical that considerable areas of the better second-growth forest lands will be used for growing pulpwood rather than saw timber. In many places, both saw timber and pulpwood will be grown together, particularly on publicly owned forest land.

The consumption of domestic pulpwood by Lake States' mills during two recent five-year periods was as follows:

Table 5.--Consumption of regionally produced pulpwood by Lake States pulp mills.

| Pulpwood species | Average annual consumption 1935-39 | Average annual consumption 1940-44 | Increase in second 5-year period |
|---|---|---|---|
| | Thousand cords | Thousand cords | Percentage |
| Spruce | 389 | 416 | 7 |
| Balsam fir | 216 | 236 | 9 |
| Hemlock | 278 | 332 | 19 |
| Jack pine | 224 | 418 | 86 |
| Aspen | 113 | 327 | 190 |
| Miscellaneous | 35 | 23 | -34 (decrease) |
| Total | 1,255 | 1,752 | 40 |

# A Look Ahead

## Probable Trends in Utilization

The trend in use of different species for pulpwood indicates the efforts of the industry to adjust its processes to available timber supplies and its ability to vary the product to take advantage of new markets and new competition. For example, aspen has been used in increasing quantities because of improvements in pulping and paper-making processes. Technical improvements may also open the way to increased utilization of northern hardwoods.

## Production of New Forest Crops

Decreased fire, insect, and disease losses in recent years, combined with favorable weather, have permitted many deforested areas to restock naturally and young stands to improve in density. In the past 10 years, areas classified as deforested or unsatisfactorily restocked to seedlings and saplings have declined from 21 million to 14 million acres. However, the Lake States forests at present are growing at not more than one-third of their potential capacity. The chief reason for low growth is understocking, the result of past cutting practices, inadequate seed trees, and fire. Also, many areas are growing species poorly adapted to the soil.

Some aspen areas are changing over naturally to pine, balsam, maple, and other more valuable tree species. Balsam fir is coming in very extensively over large areas. In 20 to 30 years substantial volumes of merchantable pulpwood timber will again be available if proper care is taken of existing young stands.

## Factors Relating to Competition for Wood by Various Forest Industries

Fifteen central Wisconsin counties contain 60 percent of the pulp mills in the State, 20 percent of the larger sawmills, and 50 percent of the veneer mills, plus several other wood-using plants. These industries process approximately 40 percent of all the timber cut in the Lake States region. This concentration of forest industries caused early depletion of nearby timber stands, leaving only the smaller and inferior trees. These industries must now obtain their wood supplies from more remote areas. Industries located in Minnesota and Michigan resent to some extent competition with Wisconsin mills in their own back yard and there is some talk of legislation to limit out-of-state shipment of wood. The Province of Ontario, Canada, requires that half of the pulpwood harvested there be processed in Canada.

Some adjustments have occurred in Wisconsin when sawmills closed or moved to new locations. Pulp mills, however, are largely tied to present locations. As wartime competition for raw materials increased, Wisconsin mills depended more and more on Michigan and Minnesota for their pulpwood, areas previously considered as within the exclusive territory of pulp mills in those states.

## Supply Situation for the Pulp and Paper Industry

An analysis of the supply and demand as regards spruce, balsam fir, and jack pine pulpwood shows an alarming situation. The supply of spruce, the most valued pulpwood species in the Lake States, has declined greatly in recent years, forcing pulp mills to use increasing quantities of balsam fir, jack pine, hemlock, and aspen.

A few mills with their own supply of spruce can continue present rates of production for some years to come, but regional consumption of spruce must inevitably go down unless imports increase. Black spruce, which makes up 70 percent of all spruce volume in the Lake States, is a swamp species which grows slowly. The remaining merchantable black spruce forests are for the most part over 100 years old and over large areas do not average more than 6 to 8 cords to the acre, largely in trees below 10 inches in diameter. Trees 3 inches in diameter are often 70 to 80 years old or older, because of soil and climatic conditions. On the drier, more favorable sites, black spruce grows to pulpwood size (averaging 6 inches in diameter) in from 50 to 60 years. In typical black spruce swamps, however, growth ranges from 1/15 to 1/5 of a cord per acre per year. There are about 4 million acres of spruce forests in the Lake States of which about 25 percent is in merchantable stands. Even at the low rate of 1/8 cord per acre growth, they could eventually be made to yield 500,000 cords annually.

The jack pine situation is no more favorable than that for spruce. Accessible stands are heavily depleted and there are no appreciable uncut areas except in northeastern Minnesota.

There are roughly 20 million acres of aspen in the Lake States (covering 40 percent of the commercial forest land area), varying from open to dense stands and from low to high productivity. Only about 5 million acres now bear merchantable stands, but present use of aspen is about one-third of the growth. The present drain on aspen of pulpwood quality, including use not only for pulp but for lumber, box boards, excelsior, etc. is about 700,000 cords per year, whereas the estimated allowable pulpwood drain is over 2 million cords. That pulp companies are using increasing quantities of aspen is shown by the data in table 6.

Table 6.--Use of aspen for pulpwood: 1920-1944.

| Year | Aspen pulpwood used | Proportion of all species used |
|---|---|---|
| | Thousands of cords | Percent |
| 1920 | 3 | 0.2 |
| 1925 | 19 | 1.0 |
| 1930 | 67 | 4.0 |
| 1935 | 63 | 4.0 |
| 1940 | 174 | 9.0 |
| 1941 | 281 | 13.0 |
| 1942 | 401 | 17.0 |
| 1943 | 417 | 18.0 |
| 1944 | 439 | 18.4 |

## The Problem of Future Pulpwood Supplies

A major problem is to improve cutting methods in Lake States' forests so that cutover lands will be left in condition to yield continuous crops. This can often be accomplished by removing the present crop in a series of light cuttings, first as thinnings, later by partial removal of crop trees, and then the final harvest, instead of the current practice of clear cutting. The land should be occupied with growing trees as much of the time as possible.

Another necessary step is to further increase the use of aspen and other little-used species to tide over the industry until crops of more valuable trees can be grown. Also, more complete utilization of the trees cut will add appreciably to the yield of pulpwood.

A third problem is to restore the 14 million acres of denuded and poorly stocked land into a valuable forest. Part of this will be accomplished by planting, in some cases by solid plantings of large blocks, thousands of acres in extent and in other cases by spot planting or strip planting to stimulate the natural conversion of aspen and brushlands to more valuable types. A reforestation program by public agencies should be adequately financed on a continuing basis.

## Conclusion

The pulp and paper industry in the Lake States region is strategically located with regard to local and national markets. If sufficient attention is given to the problem of providing its wood needs, the industry can be maintained indefinitely and may even expand. However, there must be a change of attitude on the part of the industry toward the use of raw materials. The forest must be treated as a renewable resource rather than as a mine. Also, pulpwood operations must be integrated with those of other forest users.

The 50 million acres of commercial forest land in the Lake States can meet the requirements of accessibility, productivity, and cheapness to reproduce if handled under proper management. More rapid forest growth rates in the South and West are offset by higher freight charges to national markets. Under normal conditions of competition, the pulp and paper industry of the Lake States has as good if not better opportunities for permanent and sustained production as those of any other region.

As previously noted, there is a growing tendency on the part of pulp mills to develop their own supplies of pulpwood. Cutting on their own lands can be limited to the amount necessary to meet the gap between requirements and the available supplies from other sources. The industry might well adopt a policy of promoting good forest conservation practices on all forest lands, regardless of who owns them. Both pulp and paper companies should have a very definite concern about future pulpwood supplies, and forestry is essential if continuous production is to be achieved.